

Plant Document Analysis

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End of Engineering Analysis Report

ENGINEERING SPECIFICATION ANALYSIS

Focus Area: Unfired Pressure vessels

Generated on December 03, 2025

Focus area Unfired Pressure Vessels

- ASME Boiler & Pressure Vessel Code, Section VIII (Div.1 / Div.2) — design code reference cited in document.
- API / industry practice for vessel nozzles, manways, corrosion allowance and MDMT (as relevant to items explicitly referenced in the document).

Section 1: Accepted Specifications for Evaluation of Unfired Pressure Vessels

- Design and construction code: ASME Section VIII Div.1 or Div.2 (document states vessels, columns, reactors will follow ASME Section VIII Div I or Div 2).
- Minimum design life: 20 years (project design life given in Section 2.1).
- Material selection: Primary metallurgy to be advised by Licensor/BEC via Material Selection Diagram (MSD) and individual data sheets (document requires Licensor/BEC input).
- Corrosion allowances for static equipment:
 - Carbon steel / low alloy steel (up to 2¼% Cr): 3 mm minimum.
 - Low alloy steel (above 2¼% Cr and up to 9% Cr): 1.5 mm minimum.
- Cladded/overlaid equipment:
 - Minimum cladding thickness: 2 mm.
 - If cladded, cladding thickness considered as corrosion allowance with minimum of 3 mm.
- Weld overlay: undiluted overlay thickness considered CA with minimum 3 mm.
- Storage tanks (as a subset of vessels): corrosion allowance:
 - Shell and bottom: 1.5 mm.

- Roof: 1.0 mm.
- Minimum nozzle size on pressure vessels: 1½" (document: "On pressure vessels, minimum nozzle size shall be 1 ½").
- Nozzles and connections: connections shall be flanged unless welded construction is preferred for safety reasons; separate 2" nozzle shall be provided as steam-out or utility connections (general vessel nozzle guidance).
- Vent and drain nozzle sizing by vessel volume:
 - Vent: up to 6 m³ → 1½" ; above 6 m³ → 2".
 - Drain: up to 6 m³ → 1½" ; 6.1 to 15 m³ → 2" ; above 15 m³ → 3".
- Manways / manholes:
 - On unlined horizontal vessels: manway at or below horizontal centerline (guideline).
 - Manhole sizes: vessel dia 900–1500 mm → 20" NB; above 1500 mm → 24" NB; minimum ID of manhole = 20".
- Vacuum and steam-out design:
 - Columns and vessels subjected to steam-out to be designed for at least half vacuum (0.5 kg/cm² a) (document states steam-out and vacuum design requirements).
 - Steam condensers, steam reboilers, condensate pots, direct steam injection equipment to be designed for full vacuum.
- Design pressure determination rules and margins:
 - The document prescribes margins to be added to maximum operating pressure to obtain design pressure; table entries include:
 - Vacuum to 1.8 kg/cm² g (25 psig) → typical design pressure 3.5 kg/cm² g (50 psig).
 - to 17.6 kg/cm² g (25–250 psig) → Design = Max Operating + 1.8 kg/cm² g (25 psig).
 - to 35.2 kg/cm² g (250–500 psig) → Design = Max Operating × 1.1.
 - to 70.3 kg/cm² g (500–1000 psig) → Design = Max Operating + 3.5 kg/cm² g (50 psig).
 - Over 70.3 kg/cm² g (1000 psig) → Design = Max Operating × 1.05.
- Minimum Design Metal Temperature (MDMT) rule (OSBL guidance):
 - MDMT = most stringent of: minimum ambient – 5.6 °C, minimum operating temperature – 5.6 °C, and minimum equipment temperature caused by depressuring to constant superimposed back pressure of flare header. (Document states the 5.6 °C margin is not applied to depressuring criterion.)
- Design Temperature guidance (OSBL):
 - Where not specified elsewhere, Design Temperature = 28 °C plus coincidental temperature at the Design Pressure. For temperatures beyond 343 °C, alternative rule: 14 °C plus coincidental temperature at the Design Pressure (document wording).

- Mechanical design practice: vessel diameter specified on ID basis; proven rating calculations to be used, documented and verified.

- Requirements for manways, access and removable internals (thickness minima for removable trays/internals referenced; relevant for internals access and vessel openings).

Section 2: Measurements Provided in Document

(Explicit numeric values in the document that are directly relevant to unfired pressure vessel design)

- Project design life: 20 years.
- Corrosion allowances:
 - Carbon Steel / Low Alloy Steel (up to 2¼% Cr): 3 mm.
 - Low Alloy Steel (above 2¼% Cr up to 9% Cr): 1.5 mm.
 - Minimum cladding thickness: 2 mm.
 - Cladding considered CA with minimum 3 mm (if cladded).
 - Weld overlay CA minimum: 3 mm.
- Storage tank corrosion allowance:
 - Shell & bottom: 1.5 mm; roof: 1.0 mm.
- Minimum nozzle size on pressure vessels: 1½".
- Vent nozzle sizes:
 - up to 6 m³ → 1½" ;
 - above 6 m³ → 2".
- Drain nozzle sizes:
 - up to 6 m³ → 1½" ;
 - to 15 m³ → 2" ;
 - above 15 m³ → 3".
- Manway sizes:
 - Vessel dia 900–1500 mm → 20" NB.
 - Vessel dia >1500 mm → 24" NB.
- Minimum manhole ID: 20".
- Design pressure margin table (explicit numeric entries):
 - Vacuum to 1.8 kg/cm² g → design 3.5 kg/cm² g.
 - to 17.6 kg/cm² g → design = Max Operating + 1.8 kg/cm² g.

- to 35.2 kg/cm² g → design = Max Operating × 1.1.
- to 70.3 kg/cm² g → design = Max Operating + 3.5 kg/cm² g.
- Over 70.3 kg/cm² g → design = Max Operating × 1.05.
- MDMT rule: apply −5.6 °C to ambient / minimum operating temperature to determine MDMT (explicit).
- Vacuum/steam-out design requirement: design for at least half vacuum (0.5 kg/cm² a) for columns & vessels subjected to steam-out (explicit).
- Minimum tube and exchanger-related tube OD/thickness numbers (relevant where vessels integrate with exchangers / reboilers): preferred tube lengths and tube OD minima referenced (not vessel internal to vessel), included in document but peripheral.
- Minimum design temperature specification: default 28 °C plus coincidental temperature (explicit).
- On spheres/bullets MOC: SA 516 Gr 60 only (applies to pressure vessels of that shape).

Section 3: Inputs and Additional Requirements from Client (as given in the document or explicitly called out as needed)

- Inputs provided in the document:
 - Licensor / BEC to advise primary metallurgy via Material Selection Diagram (MSD) and individual data sheets.
 - Vessel design and rating must follow final material balances and licensor data sheets; mechanical design to follow ASME VIII Div.1 or Div.2.
 - Manway / nozzle sizing rules and minimums (see Section 2 bullets).
 - Design pressure margins and MDMT determination rules (documented).
 - Vacuum/steam-out design expectations (0.5 kg/cm² a for steam-out).
 - Additional information explicitly requested or to be provided (document states these are required but does not provide the values):
 - Final material grades and Material Selection Diagram (MSD) from Licensor / BEC (document requires but does not include specific MOC per vessel/service).
 - Final operating conditions (maximum operating pressure, normal and maximum operating temperatures) per vessel — the document prescribes how to compute design pressure but does not list per-vessel operating pressures or temperatures.
 - Vessel-specific nozzle loads, nozzle orientation/locations, and external loadings — document refers to P&IDs; and datasheets but provides no nozzle load data.
 - Exact corrosion allowance application for tubes (document states tube CA is different/excluded but does not provide tube CA values for vessels).

- Confirmation of which ASME Division (I or II) applies for each vessel (document allows either but expects licensor/DEC to define).
- MDMT verification inputs where depressuring criteria control MDMT (document notes depressuring may control MDMT).
- Any special vacuum design exceptions or protective measures for items where full vacuum design is impractical (document notes drawing in air/N2 as alternative).
- Any licensor-specified deviations to the general rules (document repeatedly defers to licensor/DEC where ISBL items are concerned).
- For storage tanks vs. pressure vessels: confirmation whether the vessel falls under API 650 / API 620 / ASME VIII (document gives tank-code guidance but requires DEC/licensor confirmation).
- Missing explicit measurement data in document (items the vessel analyst will need but which are not present in the document and are explicitly required from process/vendor per the document):
 - Vessel specific: MAWP / maximum operating pressure, normal operating pressure and temperature, upset temperature cases, static head (liquid head) values, internal/external corrosion allowance justification per service, fluid physical properties, internal attachments/weights, nozzle and attached piping loads, external loads (wind, seismic) specific to vessel location, required relief scenarios and PSV set pressures, and hydrotest pressures.
 - Vendor / Licensor data sheets and P&IDs; referenced but not included in this document; these are required to complete vessel mechanical design and verification.
 - The document repeatedly states that Licensor/BEC/DEC must supply final process data, MSD and vessel datasheets; the BEDD provides guidelines but not the vessel-by-vessel data.
 - For ISBL items, licensor guidelines take precedence over these OSBL guidance notes where conflicts exist (document explicit).

End — this extraction lists only items explicitly stated in the provided document that are relevant to Unfired Pressure Vessels and identifies the additional inputs the document itself calls out as required for a complete unfired pressure vessel design/analysis.

End of Engineering Analysis Report